

AD-A167 248 INDIAN ISLAND FLEET MOORINGS UNDERWATER INSPECTION  
REPORT(U) NAVAL FACILITIES ENGINEERING COMMAND  
WASHINGTON DC CHESAPEAKE DIV APR 83

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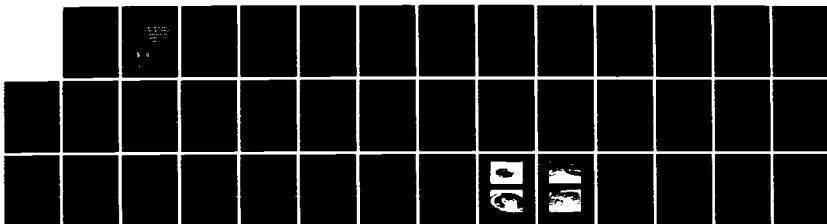
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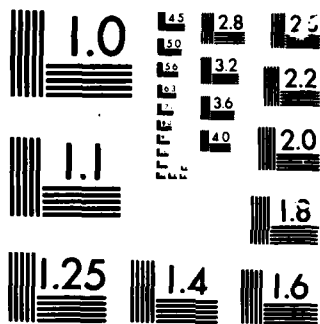
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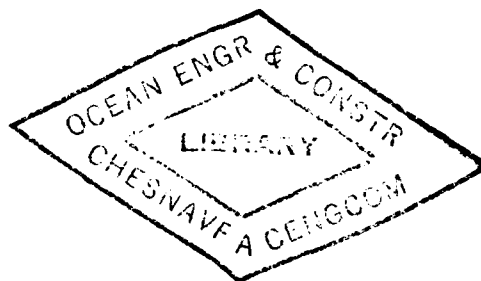


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AD-A167 248



# INDIAN ISLAND FLEET MOORINGS UNDERWATER INSPECTION REPORT

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OCEAN ENGINEERING  
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NAVAL FACILITIES ENGINEERING COMMAND  
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SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION

Unclassified

1b. RESTRICTIVE MARKINGS

2a. SECURITY CLASSIFICATION AUTHORITY

3. DISTRIBUTION AVAILABILITY OF REP.

Approved for public release;  
distribution is unlimited

2b. DECLASSIFICATION/DOWNGRADING SCHEDULE

4. PERFORMING ORGANIZATION REPORT NUMBER

FPO-1-83(2)

5. MONITORING ORGANIZATION REPORT #

6a. NAME OF PERFORM. ORG. 6b. OFFICE SYM

Ocean Engineering  
& Construction  
Project Office  
CHESNAVFACENGCOM

7a. NAME OF MONITORING ORGANIZATION

6c. ADDRESS (City, State, and Zip Code)

BLDG. 212, Washington Navy Yard  
Washington, D.C. 20374-2121

7b. ADDRESS (City, State, and Zip )

8a. NAME OF FUNDING ORG. 8b. OFFICE SYM

9. PROCUREMENT INSTRUMENT INDENT #

8c. ADDRESS (City, State & Zip)

10. SOURCE OF FUNDING NUMBERS

PROGRAM ELEMENT #	PROJECT #	TASK #	WORK UNIT ACCESS #

11. TITLE (Including Security Classification)

Indian Island Fleet Moorings Underwater Inspection Report

12. PERSONAL AUTHOR(S)

13a. TYPE OF REPORT

13b. TIME COVERED

FROM TO

14. DATE OF REP. (YYMMDD)

83-04

15. PAGES

36

16. SUPPLEMENTARY NOTATION

17. COSATI CODES

FIELD	GROUP	SUB-GROUP

18. SUBJECT TERMS (Continue on reverse if nec.)

Moorings inspections, Indian Island  
Underwater inspection.

19. ABSTRACT (Continue on reverse if necessary & identify by block number)

The inspection report contains an evaluation of the three moorings located at NAVUSEAWARENGSTA DET Indian Island, WA. This information is based on an underwater inspection of these moorings by CHESNAVENGCOM using divers from the Explosive Ordnance Disposal Group One (EODGRUONE) DET Keyport (Con't)

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT  
SAME AS RPT.

21. ABSTRACT SECURITY CLASSIFICATION

22a. NAME OF RESPONSIBLE INDIVIDUAL

Jacqueline B. Riley

DD FORM 1473, 84MAR

22b. TELEPHONE

202-433-3881

22c. OFFICE SYMBOL

SECURITY CLASSIFICATION OF THIS PAGE

BLOCK 19 (Con't)

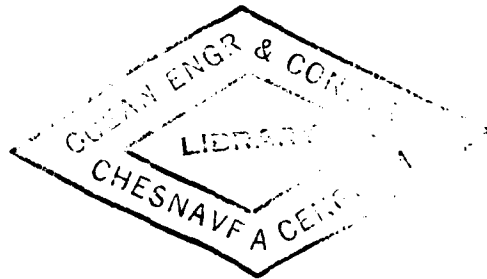
during the period 8-11 November 1982.

The results of this inspection revealed one major deficiency: Mooring number 1 has moved from its desired location. Recommend the cause of the failure be investigated and the mooring be redesigned and reinstalled. Comments concerning the specific condition of each of the moorings are included.

## ABSTRACT

This inspection report contains an evaluation of the three fleet moorings located at NAVUSEA-WARENGSTA DET Indian Island, WA. This information is based on an underwater inspection of these moorings by CHESNAVFACENGCOM using divers from the Explosive Ordnance Disposal Group One (EODGRUONE) DET Keyport during the period 8- 11 November 1982. <

The results of this inspection revealed one major deficiency: Mooring number 1 has moved from its desired location. Recommend the cause of the failure be investigated and the mooring be redesigned and reinstalled. Comments concerning the specific condition of each of the moorings are included. *Underwater inspection.*



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## 1.0 INTRODUCTION

### 1.1 Background

Under the COMNAVFACENGCOM Fleet Mooring Maintenance (FMM) Program, CHESNAVFACENGCOM has been assigned the responsibility to plan and conduct periodic diver inspections of all fleet moorings worldwide. In carrying out this responsibility, CHESNAVFACENGCOM designated an Engineer-in-Charge (EIC) to provide inspection planning and on-site technical direction for the underwater inspection of fleet moorings located at Indian Island. The actual underwater portion of the inspection was performed by divers of Explosive Ordinance Disposal Group One, Detachment Keyport (EODGRUONE DET Keyport) which was tasked to support the EIC. A total of three fleet moorings are operated and maintained by the Indian Island Detachment, Naval Undersea Warfare Engineering Station, Keyport, Washington.

### 1.2 Mooring Historical Data

The Officer in Charge of Construction, Naval Facilities Engineering Command, Trident (OICC Trident) requested the installation of three fleet moorings off Indian Island in Puget Sound. These moorings are part of a new facility requirement for six moorings for YC and YFN ammunition barges. Due to unusual site characteristics and strict performance requirements, precise placement of these three deep water moorings was required. In June 1978, the OICC Trident requested the Ocean Facilities Engineering and Construction Project Office, Chesapeake Division, Naval Facilities Engineering Command (CHESNAVFACENGCOM) to design and install three of these moorings. These moorings were designed as modified Class E moorings, and are installed in water 85' - 100' deep. The design modification involved the lifting of the ground ring about halfway up into the water column and subsequent removal of about 50' of riser chain from between the ground ring and the buoy. This modification resulted in a much shorter than normal riser and caused the suspension of a large amount of ground leg chain in the water column. The purpose of the design is to reduce the watch circles to about half of their normal size in order to maintain a certain minimum separation between watch circles and to satisfy Explosive Safety Quantity Distance (ESQD) requirements.

Using a government team consisting of a dive team from the Civil Engineering Laboratory; a crane barge, tugs, and operating personnel from the State of Washington Army National Guard; and mooring riggers from the Navy Public Works Center, San Diego; CHESNAVFACENGCOM installed moorings numbers 1, 2, and 6 during the period 29 January - 3 February 1979 (see Figures 1 and 2). In addition, all three moorings were pull tested to their design load of 12,000=. Figure 3 is a schematic drawing of a typical riser-type mooring.

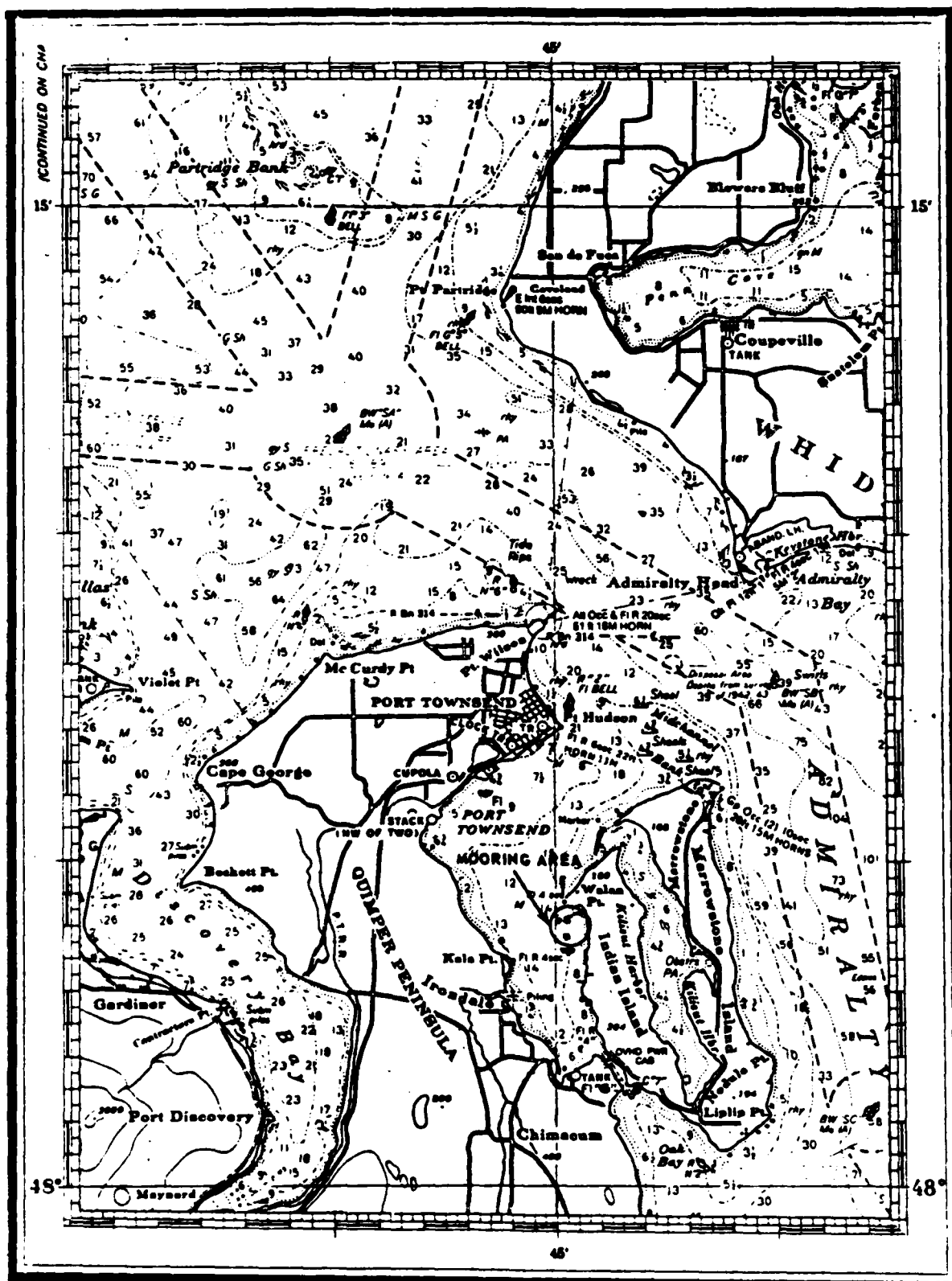


FIGURE 1. LOCATION OF INDIAN ISLAND OFF ADMIRALTY INLET, PUGET SOUND

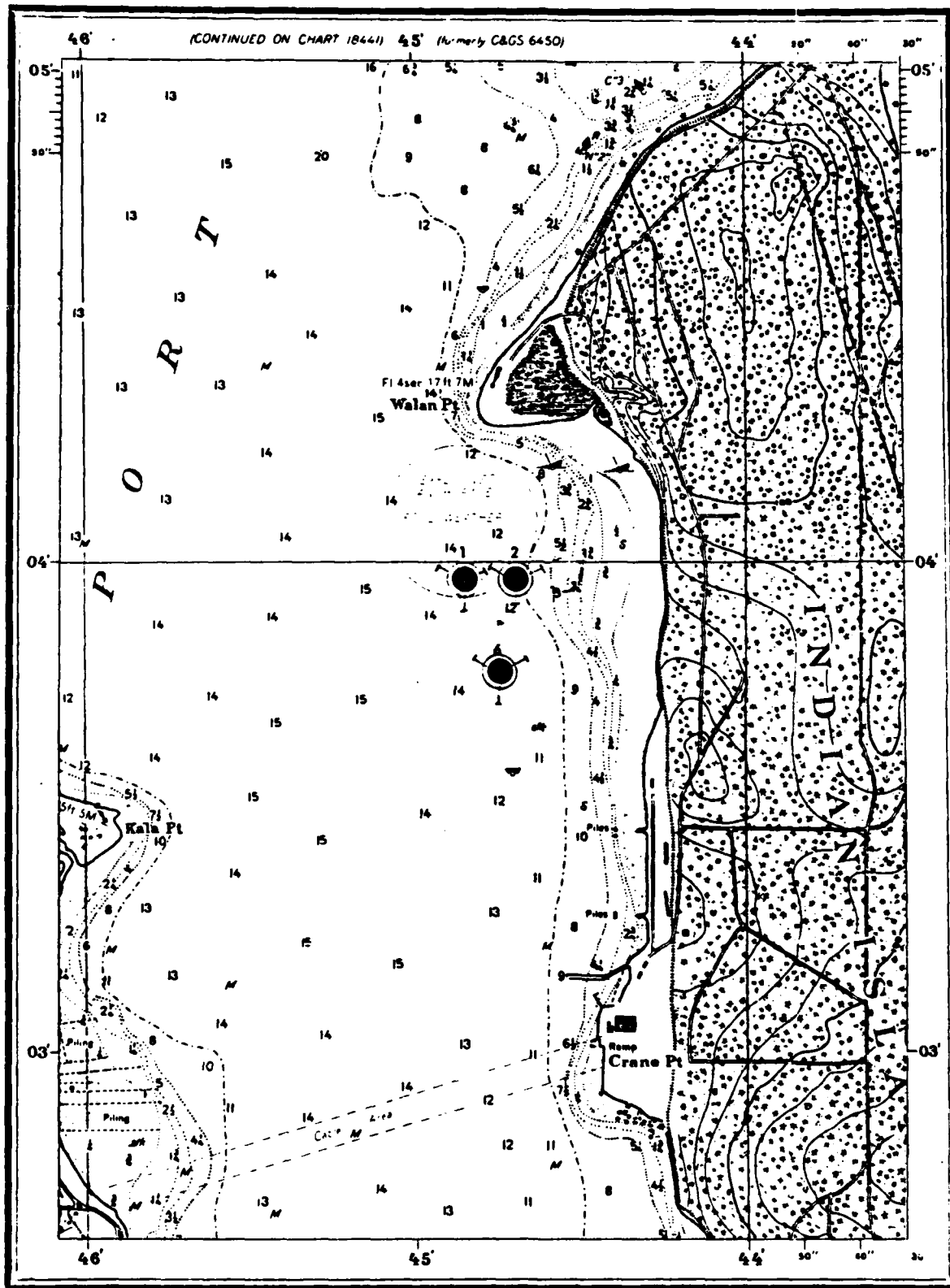


FIGURE 2. PLACEMENT OF MOORINGS OFF INDIAN ISLAND

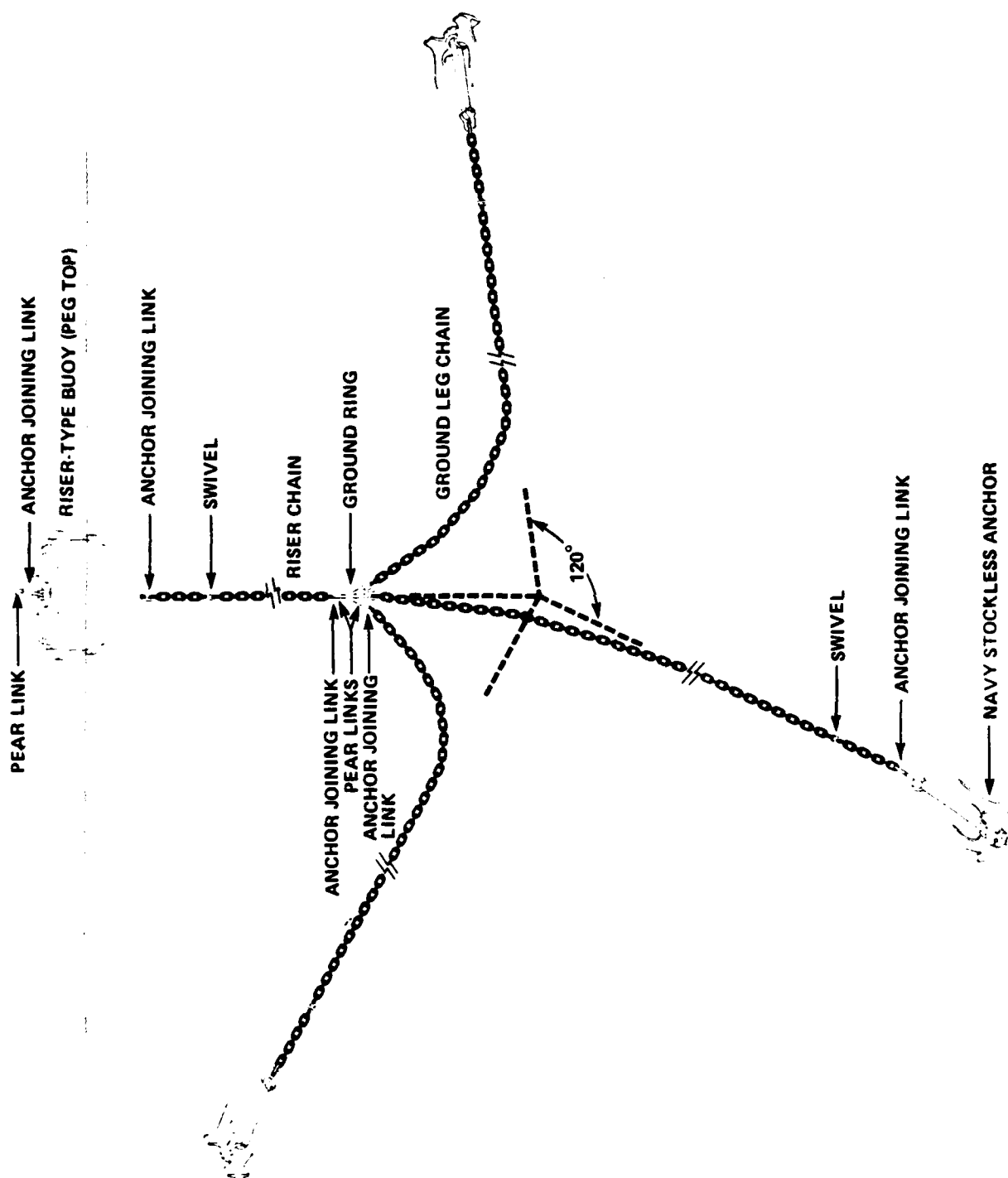


FIGURE 3. TYPICAL RISER-TYPE MOORING

## 2.0 INSPECTION PROCEDURES

**2.1 Inspection Objectives.** The purpose of the mooring inspections is to determine the general physical condition of the buoys and chain assemblies and, when possible, to verify or update existing as-built and maintenance records. Divers inspect only a portion of the submerged buoy hull and chain assemblies in order to compile a general description of the mooring's condition. The existence of fairly consistent measurements during this inspection provides a good indication of the mooring's overall condition. It should be kept in mind that periodic underwater inspections are intended as an expedient and relatively inexpensive supplement to accurate maintenance records. As such, they cannot fully substitute for a complete inspection involving recovery of the mooring and the measurement and evaluation of each component.

One of the more important parameters used to evaluate the condition of a mooring is chain wire diameter. After cleaning to bare metal, a selective sampling of the wire diameter of chain links and connecting hardware is taken in order to determine the amount of deterioration due to corrosion and wear. "Single Link" measurements are taken where chain is slack, and detect only corrosion loss. "Double Link" measurements, taken where two links connect under tension, detect the combined effects of corrosion and wear. Chain links and other components which measure 90% or greater of original wire diameter are considered to be in "good" condition; measurement between 80% and 90% of original diameter is considered "fair" condition and is cause for the mooring to be downgraded in classification; any measurement less than 80% is considered "poor" and is cause for the mooring to be declared unsatisfactory for fleet use.

Standard underwater inspection procedures do not call for the inspection of any part of the mooring which has been buried. Ground legs and risers are observed only to the point at which they become buried; no attempt is made to locate and inspect anchors or other mooring materials which are not readily visible.

**2.2 Buoy.** The buoy was inspected and its general condition determined. The buoy markings were noted and checked for conformance with those noted in applicable charts. The buoy diameter was measured and recorded along with the freeboard dimensions. Physical damage, such as holes or dents, was reported. The paint was checked for cracking, chipping, and peeling. Hatches, openings, and penetrations were examined and broken parts and rust were reported.

The buoy fenders and chafing rails were checked for integrity and secure connection to the buoy.

The buoy top chain jewelry was inspected and measured with calipers if their condition indicated significant wear.

Divers inspected the buoy below the waterline. The thickness of marine growth was recorded, three one-foot-square areas were selected and cleared of growth, and the condition of the paint was noted.

On all moorings, the bottom chain jewelry connecting the buoy to the riser was visually inspected for corrosion and/or wear.

**2.3 Riser.** To determine chain wear, each riser chain was inspected by taking three (3) consecutive double-link measurements, using calipers, at both ends and at the center of the riser. Divers also confirmed the type of hardware connecting the riser chain to the ground ring.

**2.4 Ground Legs.** To determine chain wear, three (3) consecutive double link measurements were made at both ends and at the center of each leg until the chain was buried in the seafloor. The hardware connecting the ground legs to the ground ring was inspected. The length of chain from the ground ring to the point where the chain was buried in the mud was recorded.

In addition, divers measured the catenary of each ground leg using an inclinometer and a depth gauge. The catenary angle was measured, as shown in Figure 4, just below the ground ring, at the mud line, and halfway between these two points. A pop float was attached to the ground leg at the point it met the bottom (and the water depth recorded) so that topside personnel could measure the horizontal distance between the buoy and the point at which the ground leg reached the bottom. This data determines the catenary profile of each ground leg.

**2.5 Ground Ring.** The ground ring was examined for general and localized wear. The depth of water at the ground ring was recorded by the divers.

**2.6 Anchors.** All anchors were buried in the bottom and not observed.

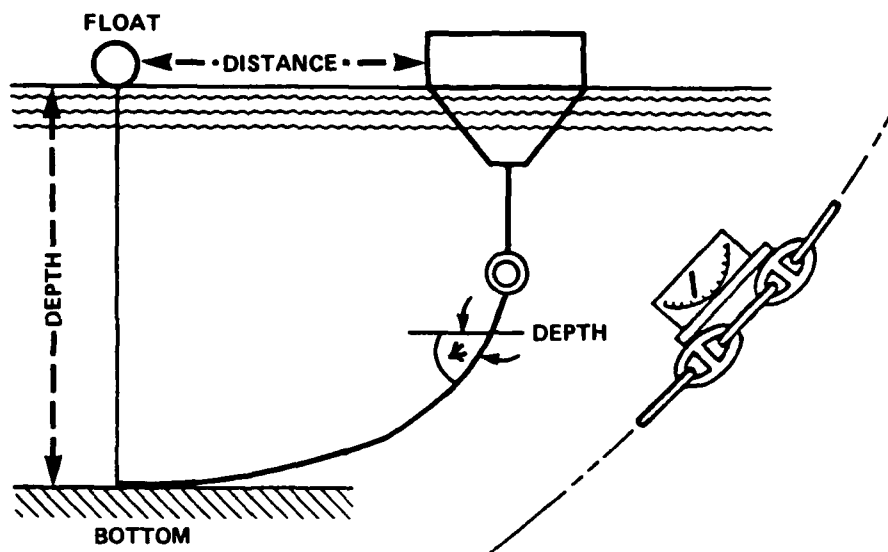


FIGURE 4. DETERMINING CATENARY PROFILES

### 3.0 INSPECTION SUMMARY

The data obtained from the divers, along with the maintenance records and as-built documentation, indicates the following:

- The chain assemblies are in good condition. In all cases where the chain was measured, it was found to be greater than 90% of its original wire diameter.
- Double link measurements of the detachable links connecting the swivel to the riser in all three moorings were found to be between 80 and 90 percent of their original wire diameter. However, due to the use of larger than required chain components (2 3/4" vice 1 1/2"), there is adequate chain strength left to withstand the anticipated forces on the mooring.
- The catenaries formed by the ground legs of mooring numbers 2 and 6 indicate that these moorings are still properly pretensioned. Sightings from land and measurement of the catenaries of mooring number 1, however, indicate that this buoy has moved from its intended position and is not properly pretensioned. Leg B of mooring number 1 was found to be slack.

- The three buoys exhibited moderate rusting and heavy marine growth. No severe rust, evidence of collision, listing, missing or damaged fenders, manholes, or bolts, or other such damage was observed.

#### **4.0 MOORING INSPECTION COMMENTS AND RECOMMENDATIONS**

As a result of an evaluation of the data gathered during the inspection, the following comments and recommendations are pertinent:

- The conditions of the buoys, chain and chain hardware indicate no serious material deficiencies. No corrective action is currently required or recommended.
- The pretension of the ground legs of moorings numbers 2 and 6 has been maintained during four years of mooring use. As a result, these moorings should meet the strict placement and watch circle requirements particular to this site. No corrective action is required or recommended.
- Mooring number 1 has moved from its desired location, is no longer properly pretensioned, and can no longer meet the strict placement and watch circle requirements particular to this site. Recommend the cause of the failure be investigated with the possibility of a redesign and reinstallation.

**ANNEX A**

**FLEET MOORING**

**INSPECTION RESULTS**

## **ANNEX A**

### **MOORING INSPECTION RESULTS**

This Annex contains, for each of the three moorings:

- A summary of the data obtained during the course of the inspection.
- Underwater inspection forms which were completed on-site.
- The mooring as-built components and dimensions.
- The measured geographic position of each buoy.
- Mooring Survey Data.
- Pop float to buoy distances as sighted from land.

## SUMMARY OF INSPECTION

### MOORING NO. 1

#### Buoy

This is a 12' diameter Mark II Peg Top type buoy. Some light to moderate rusting is evident, and the buoy's lower hull is covered with a heavy marine growth. The buoy has two wooden fenders and a chafing rail, all in good condition. The buoy's top and bottom connecting hardware appear to be in good condition. The position of the buoy is currently about 150' west of its installed position.

#### Riser

The original wire diameter of the chain was 2 1/2", which is a quarter of an inch larger than required for a Class C (2 1/4" riser) mooring. Double link measurements determined that the riser chain is greater than 90 percent of its original wire diameter. The swivel was located at about 25' of depth. Double link measurements of the top and bottom of the swivel with its detachable links were found to be between 80 to 90 percent of the as-built denoted 2 1/2" original wire diameter of the swivel. The ground ring was located at a depth of 46' and found to be in good condition.

#### Ground Legs

The three ground legs, as initially installed, are comprised of 2 1/4" chain. Each of these legs enters the mud at a depth of about 100'. Double link measurements of each leg were taken just below the ground ring, at the wear point (mud line), and halfway in between the two. Measurements were all greater than 90 percent of original wire diameter. Measurements of the catenary angles at three depths of each leg were taken, and the results are noted on the following diver report sheet. Leg B was observed to run vertically from the ground ring to the bottom.

#### Recommendation

The mooring chain is in satisfactory condition for continued use in its currently rated and tested capacity as a modified Class E mooring. However, the buoy's current position indicates a significant displacement of the ground legs and anchors. Recommend the forces on the buoy be reevaluated with the possibility of a redesign and repositioning of the mooring back to its original position.

# DIVER REPORT SHEET

MOORING NO.: 1 CLASS: MOD E LOCATION: INDIAN ISLAND LAT: 48° 03' N LONG: 123° 45' W  
 WATER DEPTH: 100' TYPE MOORING: ☒ RISER ☐ TELEPHONE ANCHOR SIZE/TYPE 20 K LBS STAINLESS BUOY TYPE HK II PIG TOP

DATE: 8 Nov 82 ENGINEER-IN-CHARGE T. JONES DIVER: EODGRU ONE DET KEYPORT

COMPONENTS	NI	CONDITION						U/W VOLT READING	COMMENT		
		NEW FROM AS-BUOYS	SINGLE LINK %			DOUBLE LINK %					
			90+	80+	80-	90+	80+			80-	
BUOY-TOP HARDWARE									N/A		
RISER	NEAR BUOY						✓✓			10'	RISER IS VERTICAL
	MIDDLE							✓✓✓		25'	NOTE (1)
	NEAR GRD RG						✓✓✓			45'	
GROUND RING										46'	
GROUND LEG NO. <u>A</u>	UPPER END							✓✓✓		50'	DEPTH CATINAREY ANGLE 40°
	WEARPOINT							✓✓✓		75'	35°
GROUND LEG NO. <u>B</u>	UPPER END							✓✓✓		100'	10°
	WEARPOINT							✓✓✓			
GROUND LEG NO. <u>B</u>	UPPER END							✓✓✓		50'	NONE. GROUND
	WEARPOINT							✓✓✓		75'	IS VERTICAL
GROUND LEG NO. <u>C</u>	UPPER END							✓✓✓		100'	G.E. TO MUD
	WEARPOINT							✓✓✓			
GROUND LEG NO. <u>C</u>	UPPER END							✓✓✓		50'	57° 52°
	WEARPOINT							✓✓✓		75'	41°
								✓✓✓		100'	NOTE (2)

BOTTOM TYPE: ☐ SAND ☒ MUD ☐ CLAY ☐ CORAL ☐ ROCK ☐ ANCHORS BURIED

Visibility N.R. D = depth NI = not inspected, inaccessible

NOTE (1) SWIVEL LOOKS GOOD WITH NO VISIBLE SIGN OF WEAR, DOUBLE LINK MEASUREMENTS OF SWIVEL AND DETACHABLE LINKS WERE BETWEEN 80 AND 90 PERCENT.  
 (2) ORIENTATION OF LEG C IS ABOUT 180° FROM LEG A.

**INDIAN ISLAND**  
**MOORING NO. 1 AS-BUILT**  
**October 1979**

**Buoy Bottom Hardware**

Pad Eye  
 3" Detachable Link — Baldt  
 Pear Link  
 2 1/2" Detachable Link — Baldt

**Riser Chain**

2 1/2" Chain (10')  
 2 1/2" Detachable Link — Baldt  
 2 1/2" Swivel  
 2 1/2" Detachable Link — Baldt  
 2 1/2" Chain (25')  
 2 1/2" Detachable Link  
 4" to 2 1/2" Anchor Joining Link — Baldt  
 4" x 10" ID Ground Ring

**Ground Leg A**

4" to 2 1/2" Anchor Joining Link — Baldt  
 2 1/4" Detachable Link  
 2 1/4" Chain (90')  
 2 1/4" Detachable Link  
 2 1/4" Chain (89')  
 2 1/4" Detachable Link  
 2 1/4" Chain (90')  
 2 1/4" Detachable Link  
 2 1/4" Chain (90')  
 2 1/4" Detachable Link  
 2 1/4" Chain (44')  
 2 1/4" Detachable Link  
 2 1/4" Swivel  
 2 1/4" Detachable Link — Baldt  
 2 1/4" Chain (25')  
 2 1/4" Detachable Link  
 2 1/4" (L = 12") D Link  
 2 3/4" (L = 20") Anchor Joining Link  
 5" (L = 21") Jew's Harp  
 20,000 ÷ Anchor

### Ground Leg B

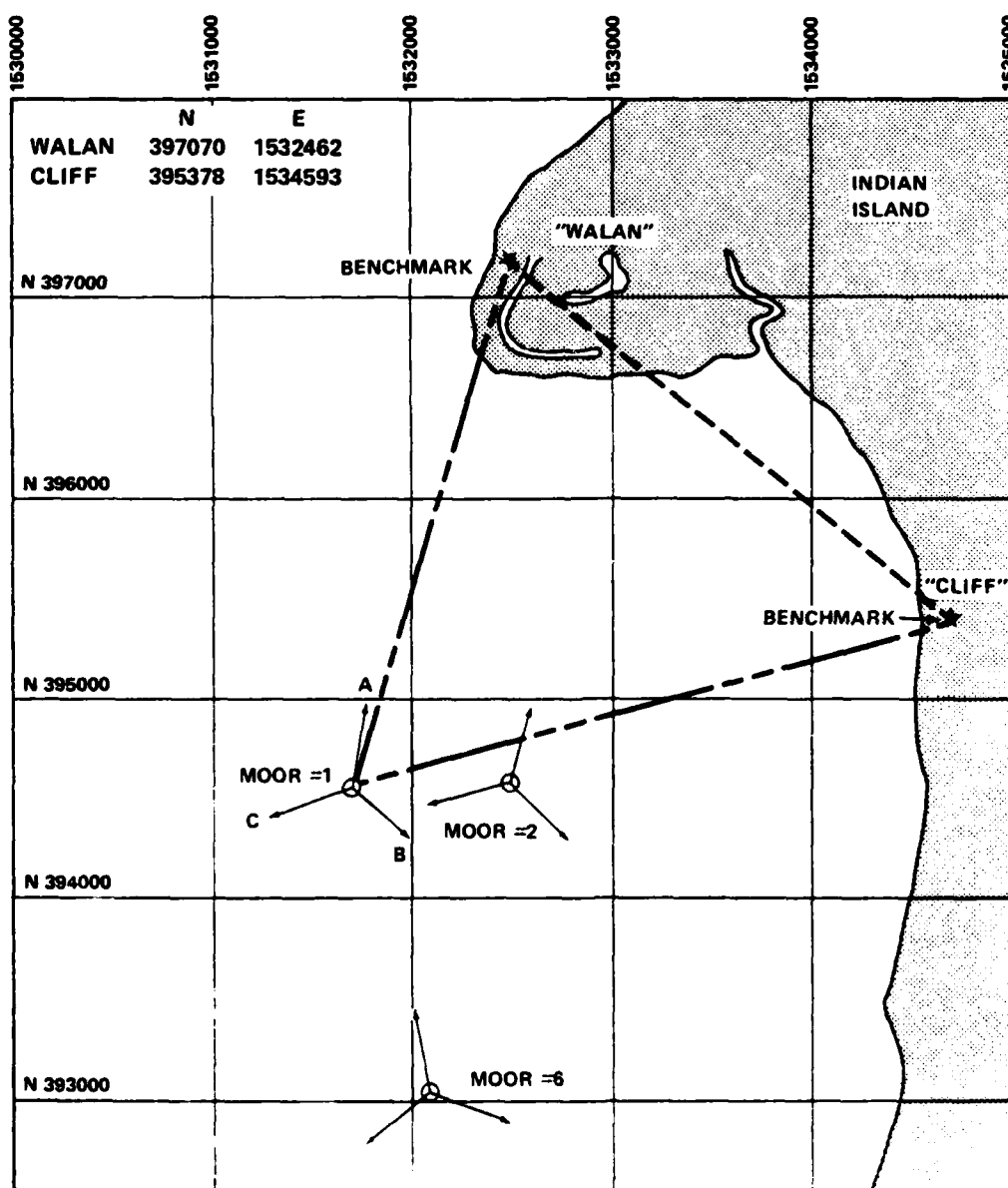
4" to 2 1/2" Anchor Joining Link — Baldt  
2 1/4" Detachable Link  
2 1/4" Chain (80')  
2 1/4" Detachable Link  
2 1/4" Chain (90')  
2 1/4" Detachable Link  
2 1/4" Chain (90')  
2 1/4" Detachable Link  
2 1/4" Chain (90')  
2 1/4" Detachable Link  
2 1/4" Chain (43')  
2 1/4" Detachable Link  
2 1/4" Swivel  
2 1/4" Detachable Link — Baldt  
2 1/4" Chain (24')  
2 1/4" Detachable Link  
2 1/2" (L = 15") Pear Link  
5" (L = 21") Jew's Harp  
20,000# Anchor

### Ground Leg C

4" to 2 1/2" Anchor Joining Link — Baldt  
2 1/4" Detachable Link  
2 1/4" Chain (90')  
2 1/4" Detachable Link  
2 1/4" Chain (90')  
2 1/4" Detachable Link  
2 1/4" Chain (90')  
2 1/4" Detachable Link  
2 1/4" Chain (90')  
2 1/4" Detachable Link  
2 1/4" Chain (43')  
2 1/4" Detachable Link  
2 1/4" Swivel  
2 1/4" Detachable Link — Baldt  
2 1/4" Chain (24')  
2 1/4" Detachable Link  
2 1/4" (L = 24") Pear Link  
4 1/4" (L = 15") Jew's Harp  
20,000# Anchor

# Survey Data: Indian Island Mooring Inspection

	Angle from Walan	Angle from Cliff	N	E	Date
Mooring #1	71° 11'	54° 13'	394519.37	1531400.55	11/8/82
Installed Position			394519.00	1531558.00	2/3/79
Leg A	69° 39'	53° 54'	562.49	511.2	11/8/82
Leg B	71° 15'	54° 13'	518.27	395.75	11/8/82
Leg C	71° 43'	55° 10'	448.27	348.59	11/8/82

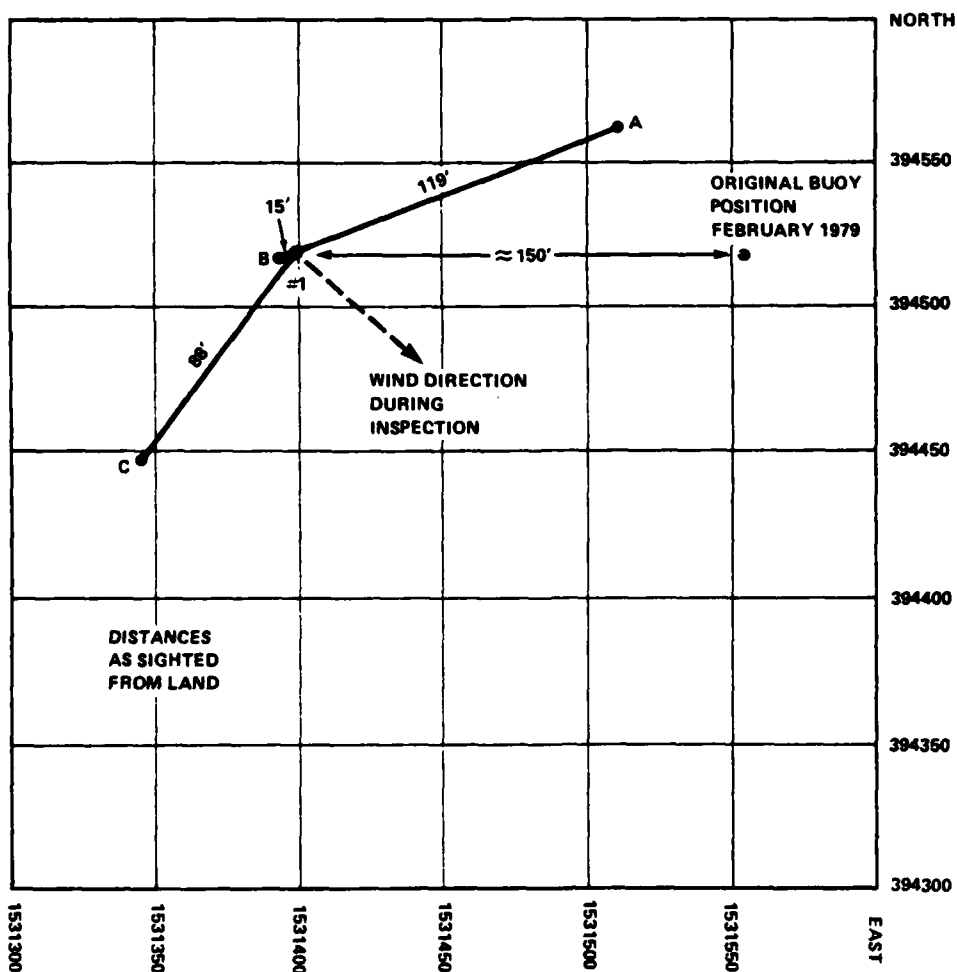


NOTE: COORDINATES IN WASHINGTON STATE LAMBERT NORTH SYSTEM

Table A-2. Pop Float to Buoy Distances as Sighted from Land  
(Indian Island)

Leg No.	Pop Float North Coord.	Pop Float East Coord.	Buoy North Coord.	Buoy East Coord.	Distance (ft)
A	394562.49	1531511.17	394519.37	1531400.55	119
B	394518.27	1531395.75			15
C	394448.27	1531348.59			88

MOORING #1  
CONFIGURATION



NOTE: (1) COORDINATES IN WASHINGTON STATE LAMBERT NORTH SYSTEM  
(2) A, B AND C ARE POSITIONS WHERE CHAIN LEGS ENTER THE BOTTOM

## SUMMARY OF INSPECTION

### MOORING NO. 2

#### Buoy

This is a 12' diameter Mark II Peg Top type buoy. Some light to moderate rusting is evident, and the buoy's lower hull is covered with a heavy marine growth. The buoy has two wooden fenders and a chafing rail, all in good condition. The buoy's top and bottom connecting hardware appear to be in good condition.

#### Riser

The original wire diameter of the chain was 2 1/2", which is a quarter of an inch larger than required for a Class C (2 1/4" riser) mooring. Double link measurements determined that the riser chain is greater than 90 percent of its original wire diameter. The swivel was located at about 25' of depth. Double link measurements of the top and bottom of the swivel with its detachable links were found to be between 80 and 90 percent of the as-built denoted 2 1/2" original wire diameter of the swivel. The ground ring was located at a depth of 46' and found to be in good condition.

#### Ground Legs

The three ground legs, as initially installed, are comprised of 2 1/4" chain. Each of these legs enters the mud at a depth of about 90'. Double link measurements of each leg were taken just below the ground ring, at the wear point (mud line), and halfway in between the two. Measurements were all greater than 90 percent of original wire diameter. Measurements of the catenary angles at three depths of each leg were taken, and the results are noted on the following diver report sheet.

#### Recommendation

This mooring is in satisfactory condition for continued use in its currently rated capacity as a modified Class E mooring.

# DIVER REPORT SHEET

MOORING NO.: 2 CLASS: Mod E LOCATION: INDIAN ISLAND LAT. 45° 03' N LONG: 122° 45' W  
 WATER DEPTH: 90' TYPE MOORING: ☒ RISER ☐ TELEPHONE 18 K LBS  
 DATE: 9 Nov 82 ENGINEER-IN-CHARGE T. JONES DIVER: EDGAR ONE DET KEYPORT ANCHOR SIZE/TYPE: STAINLESS BUOY TYPE: Mk II REG TOP

COMPONENTS	NI	CONDITION					UW VOLT READING	COMMENT
		NEW FROM 45-BUOYS	SINGLE LINK %			DOUBLE LINK %		
			90+	80+	80-	90+	80+	80-
BUOY-TOP HARDWARE								
RISER								
NEAR BUOY		2 1/2"				✓✓✓		10'
MIDDLE		↓				✓✓✓		25'
NEAR GRD RG		↓				✓✓✓		45'
GROUND RING								46'
GROUND LEG NO. <u>A</u>		2 1/4"				✓✓✓		54'
WEARPOINT		↓				✓✓✓		90'
GROUND LEG NO. <u>B</u>						✓✓✓		54'
WEARPOINT		↓				✓✓✓		68'
GROUND LEG NO. <u>C</u>						✓✓✓		89'
WEARPOINT		↓				✓✓✓		54'
						✓✓✓		70'
						✓✓✓		90'

DEPTH CATEGORY ANGLE

54' 32°

70' 30°

90' 10°

54' 32°

68' 32°

89' 10°

54' 32°

70' 31°

90' 12°

ANCHORS BURIED

BOTTOM TYPE: ☐ SAND ☒ MUD ☐ CLAY ☐ CORAL ☐ ROCK

Visibility N.R. D = depth NI = not inspected, inaccessible

NOTE(1) SWIVEL LOOKS GOOD WITH NO VISIBLE SIGN OF WEAR. DOUBLE LINK MEASUREMENTS OF SWIVEL AND DETACHABLE LINKS WERE BETWEEN 80 AND 90 PERCENT.

**INDIAN ISLAND**  
**MOORING NO. 2 AS-BUILT**  
**October 1979**

**Buoy Bottom Hardware**

Pad Eye  
3" Detachable Link — Baldt  
Pear Link  
2 1/2" Detachable Link — Baldt

**Riser Chain**

2 1/2" Chain (10')  
2 1/2" Detachable Link — Baldt  
2 1/2" Swivel  
2 1/2" Detachable Link — Baldt  
2 1/2" Chain (25')  
2 1/2" Detachable Link  
4" to 2 1/2" Anchor Joining Link — Baldt  
4" x 10" ID Ground Ring

**Ground Leg A**

4" to 2 1/2" Anchor Joining Link — Baldt  
2 1/4" Detachable Link  
2 1/4" Chain (90')  
2 1/4" Detachable Link  
2 1/4" Chain (90')  
2 1/4" Detachable Link  
2 1/4" Chain (87')  
2 1/4" Detachable Link  
2 1/4" Chain (90')  
2 1/4" Detachable Link  
2 1/4" Chain (44')  
2 1/4" Detachable Link  
2 1/4" Swivel  
2 1/4" Detachable Link — Baldt  
2 1/4" Chain (25')  
2 1/4" Detachable Link  
3" (L = 20") Pear Link  
3" (L = 12") Bending Shackle  
4" (L = 22") Jew's Harp  
18,000# Anchor

### Ground Leg B

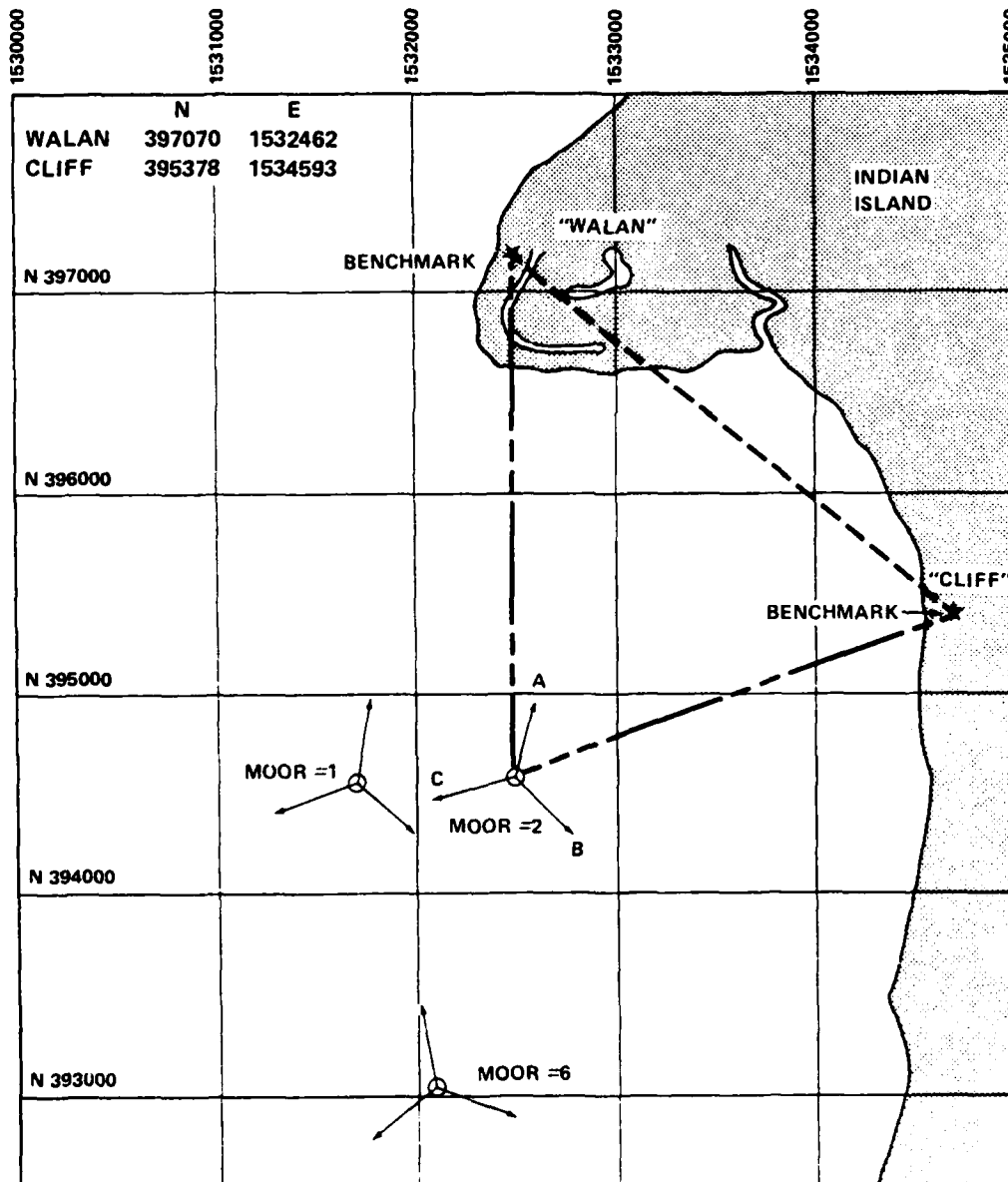
4" to 2 1/2" Anchor Joining Link — Baldt  
2 1/4" Detachable Link  
2 1/4" Chain (89')  
2 1/4" Detachable Link  
2 1/4" Chain (109')  
2 1/4" Detachable Link  
2 1/4" Chain (77')  
2 1/4" Detachable Link  
2 1/4" Chain (89')  
2 1/4" Detachable Link  
2 1/4" Chain (48')  
2 1/4" Detachable Link  
2 1/4" Swivel  
2 1/4" Detachable Link — Baldt  
2 1/4" Chain (25')  
2 1/4" Detachable Link  
2 1/4" (L = 15") Bending Shackle  
4" (L = 20") Jew's Harp  
18,000# Anchor

### Ground Leg C

4" to 2 1/2" Anchor Joining Link — Baldt  
2 1/4" Detachable Link  
2 1/4" Chain (89')  
2 1/4" Detachable Link  
2 1/4" Chain (89')  
2 1/4" Detachable Link  
2 1/4" Chain (90')  
2 1/4" Detachable Link  
2 1/4" Chain (91')  
2 1/4" Detachable Link  
2 1/4" Chain (45')  
2 1/4" Detachable Link  
2 1/4" Swivel  
2 1/4" Detachable Link — Baldt  
2 1/4" Chain (22')  
2 1/4" Detachable Link  
2 1/4" (L = 20") Pear Link  
3 1/4" (L = 12") Bending Shackle  
3 3/4" (L = 22") Jew's Harp  
18,000# Anchor

# Survey Data: Indian Island Mooring Inspection

	Angle from Walan	Angle from Cliff	N	E	Date
Mooring No. 2	54° 04'	58° 18'	394569.00	1532357.53	11/9/82
Installed Position			394572.00	1532350.00	2/3/79
Leg A	53° 28'	56° 42'	648.55	384.23	11/9/82
Leg B	52° 26'	60° 33'	517.34	437.66	11/10/82
Leg C	55° 16'	58° 34'	537.23	303.67	11/7/82

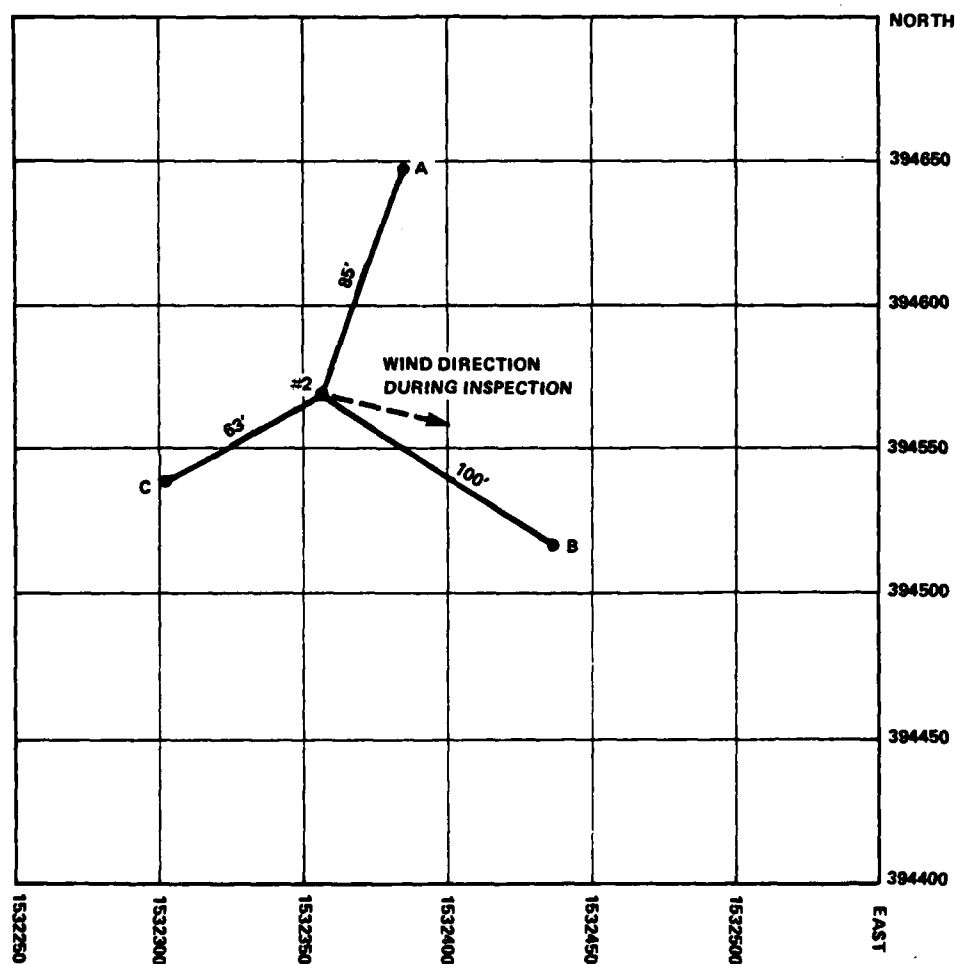


NOTE: COORDINATES IN WASHINGTON STATE LAMBERT NORTH SYSTEM

Table A-4. Pop Float to Buoy Distances as Sighted from Land  
(Indian Island)

Leg No.	Pop Float North Coord.	Pop Float East Coord.	Buoy North Coord.	Buoy East Coord.	Distance (ft)
A	394648.55	1532381.11	394569.00	1532357.53	85
B	394517.34	1532437.66			100
C	394537.23	1532297.62			63

MOORING #2  
CONFIGURATION



NOTE: (1) COORDINATES IN WASHINGTON STATE LAMBERT NORTH SYSTEM  
(2) A, B AND C ARE POSITIONS WHERE CHAIN LEGS ENTER THE BOTTOM

## SUMMARY OF INSPECTION

### MOORING NO. 6

#### Buoy

This is a 12' diameter Mark II Peg Top type buoy. Some light to moderate rusting is evident, and the buoy's lower hull is covered with a heavy marine growth. The buoy has two wooden fenders and a chafing rail, all in good condition. The buoy's top and bottom connecting hardware appear to be in good condition.

#### Riser

The original wire diameter of the chain was 2 1/2", which is a quarter of an inch larger than required for a Class C (2 1/4" riser) mooring. Double link measurements determined that the riser chain is greater than 90 percent of its original wire diameter. The swivel was located at about 25' of depth. Double link measurements of the top and bottom of the swivel with its detachable links were found to be between 80 and 90 percent of the as-built denoted 2 1/2" original wire diameter of the swivel. The ground ring was located at a depth of 48' and found to be in good condition.

#### Ground Legs

The three ground legs, as initially installed, are comprised of 2 1/4" chain. Each of these legs enters the mud at a depth of about 85'. Double link measurements of each leg were taken just below the ground ring, at the wear point (mud line), and midway between the two. Measurements were all greater than 90 percent of original wire diameter. Measurements of the catenary angles at three depths of each leg were taken, and the results are noted on the following diver report sheet. Each leg has 5' - 10' of chain on the bottom before the leg becomes buried in the mud.

#### Recommendation

This mooring is in satisfactory condition for continued use in its currently rated capacity as a modified Class E mooring.

DIVER REPORT SHEET

MOORING NO.: 6 CLASS: MOD E LOCATION: INDIAN ISLAND LAT: 48°-03'N LONG: 122°-45'W  
 WATER DEPTH: 85' TYPE MOORING: ☒ RISER ☐ TELEPHONE ANCHOR SIZE/TYP: STOCKLESS BUOY TYPE: HK 11 REG TOP  
 DATE: 9 Nov 82 ENGINEER IN CHARGE: T. JONES DIVER: EDGERD OUE DET KEYPORT

COMPONENTS	NI	CONDITION						U/W VOLT READING	COMMENT		
		NEW FROM AS-BUILT	SINGLE LINK %		DOUBLE LINK %		D				
			90+	80+	80-	90+				80+	80-
BUOY-TOP HARDWARE									N/A		
RISER	NEAR BUOY						✓✓			10'	RISER IS VERTICAL
	MIDDLE							✓✓✓		25'	NOTE(1)
	NEAR GRD RG						✓✓✓			45'	
GROUND RING										48'	
GROUND LEG NO. <u>A</u>	UPPER END							✓✓		50'	DEPTH CATENARY ANGLE
	WEARPOINT							✓✓		85'	30° 27° 0.5°
GROUND LEG NO. <u>B</u>	UPPER END							✓✓✓		50'	43°
	WEARPOINT							✓✓✓		85'	33° 7°
GROUND LEG NO. <u>C</u>	UPPER END							✓✓✓		50'	37°
	WEARPOINT							✓✓✓		85'	26° 0.3°
											NOTE(2)

ANCHORS BURIED

BOTTOM TYPE: ☐ SAND ☒ MUD ☐ CLAY ☐ CORAL ☐ ROCK

Visibility NR. D = depth NI = not inspected, inaccessible

NOTE(1) SWIVEL LOOKS GOOD WITH NO VISIBLE SIGN OF WEAR. DOUBLE LINK MEASUREMENTS OF SWIVEL AND DETACHABLE LINKS WERE BETWEEN 80 AND 90 PERCENT.

(2) DUE TO A FIRM MUD BOTTOM, EACH LEG HAS 6-10 FEET OF CHAIN ON THE BOTTOM PRIOR TO BEING BURIED. POP FLOAT MARKERS ON EACH LEG WERE TIED ABOUT 6' PRIOR TO LEG BOTTOM ENTRY.

**INDIAN ISLAND**  
**MOORING NO. 6 AS-BUILT**  
**October 1979**

**Buoy Bottom Hardware**

Pad Eye  
3" Detachable Link — Baldt  
Pear Link  
2 1/2" Detachable Link — Baldt

**Riser Chain**

2 1/2" Chain (10')  
2 1/2" Detachable Link — Baldt  
2 1/2" Swivel  
2 1/2" Detachable Link — Baldt  
2 1/2" Chain (25')  
2 1/2" Detachable Link  
4" to 2 1/2" Anchor Joining Link  
4" x 10" ID Ground Ring

**Ground Leg A**

4" to 2 1/2" Anchor Joining Link — Baldt  
2 1/4" Detachable Link  
2 1/4" Chain (90')  
2 1/4" Detachable Link  
2 1/4" Chain (90')  
2 1/4" Detachable Link  
2 1/4" Chain (90')  
2 1/4" Detachable Link  
2 1/4" Chain (90')  
2 1/4" Detachable Link  
2 1/4" Chain (45')  
2 1/4" Detachable Link  
2 1/4" Swivel  
2 1/4" Detachable Link — Baldt  
2 1/4" Chain (25')  
2 1/4" Detachable Link  
2 1/4" (L = 10") D Link  
3 3/4" (L = 16") Bending Shackle  
4" (L = 24") Jew's Harp  
18,000# Anchor

### Ground Leg B

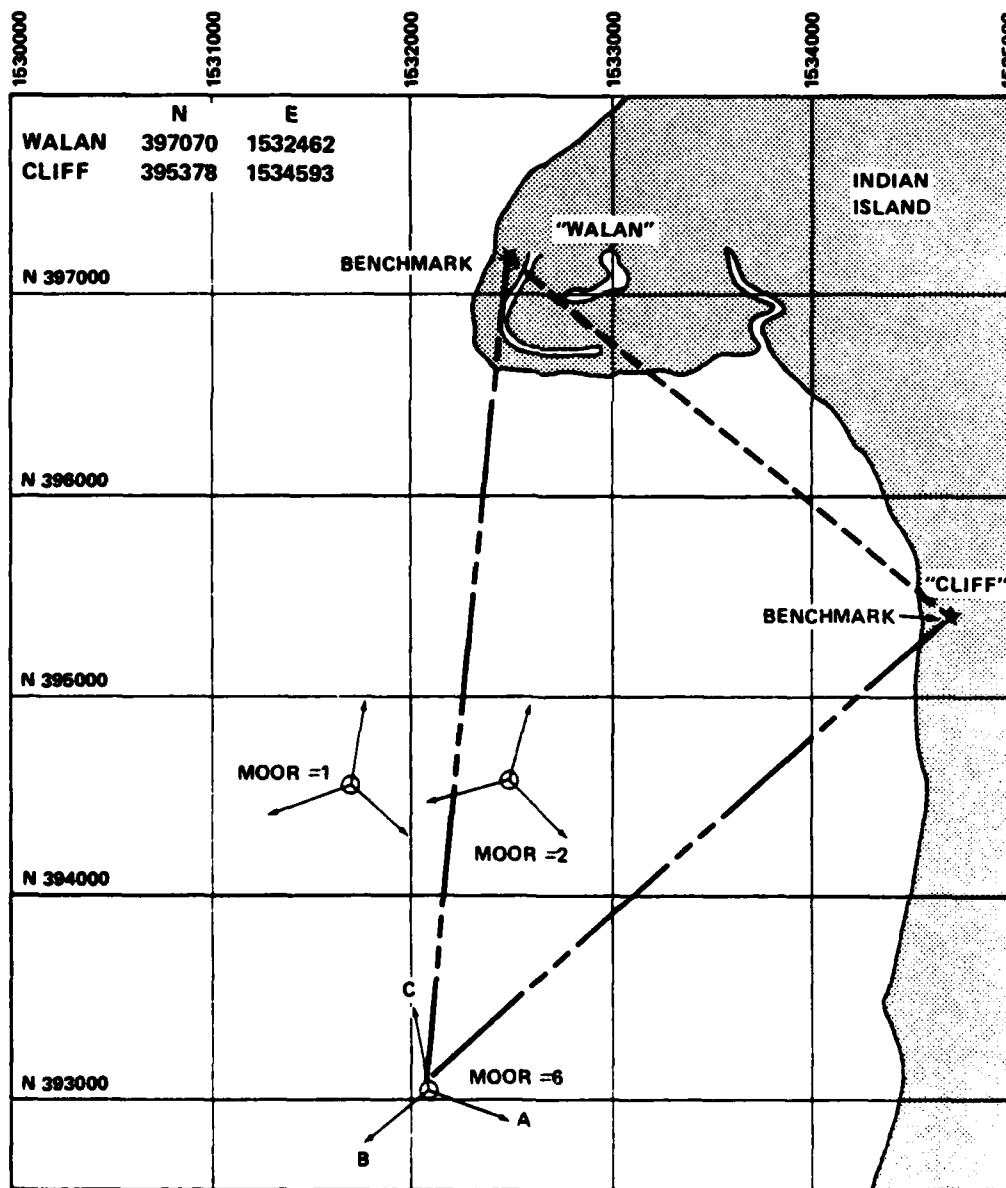
4" to 2 1/2" Anchor Joining Link — Baldt  
2 1/4" Detachable Link  
2 1/4" Chain (89')  
2 1/4" Detachable Link  
2 1/4" Chain (90')  
2 1/4" Detachable Link  
2 1/4" Chain (101')  
2 1/4" Detachable Link  
2 1/4" Chain (90')  
2 1/4" Detachable Link  
2 1/4" Chain (45')  
2 1/4" Detachable Link  
2 1/4" Swivel  
2 1/4" Detachable Link — Baldt  
2 1/4" Chain (25')  
2 1/4" Detachable Link  
2 1/2" (L = 12") Pear Link  
3 1/4" (L = 12") Bending Shackle  
4" (L = 23") Jew's Harp  
18,000# Anchor

### Ground Leg C

4" to 2 1/2" Anchor Joining Link — Baldt  
2 1/4" Detachable Link  
2 1/4" Chain (90')  
2 1/4" Detachable Link  
2 1/4" Chain (90')  
2 1/4" Detachable Link  
2 1/4" Chain (85')  
2 1/4" Detachable Link  
2 1/4" Chain (90')  
2 1/4" Detachable Link  
2 1/4" Chain (45')  
2 1/4" Detachable Link  
2 1/4" Swivel  
2 1/4" Detachable Link — Baldt  
2 1/4" Chain (25')  
2 1/4" Detachable Link  
2 3/4" (L = 15") B Link  
2 3/4" (L = 12") C Link  
3 1/2" (L = 12") Bending Shackle  
4 1/4" (L = 24") Jew's Harp  
18,000# Anchor

# Survey Data: Indian Island Mooring Inspection

	Angle from Walan	Angle from Cliff	N	E	Date
Buoy No. 6	58° 33'	80° 20'	393021.37	1531965.15	11/9/82
Installed Position			393026.00	1531963.00	2/3/79
Leg A	58° 22'	79° 34'	393104.01	1531988.16	11/9/82
Leg B	56° 47'	81° 56'	393003.80	1532089.84	11/9/82
Leg C	59° 00'	80° 53'	392935.66	1531921.64	11/9/82

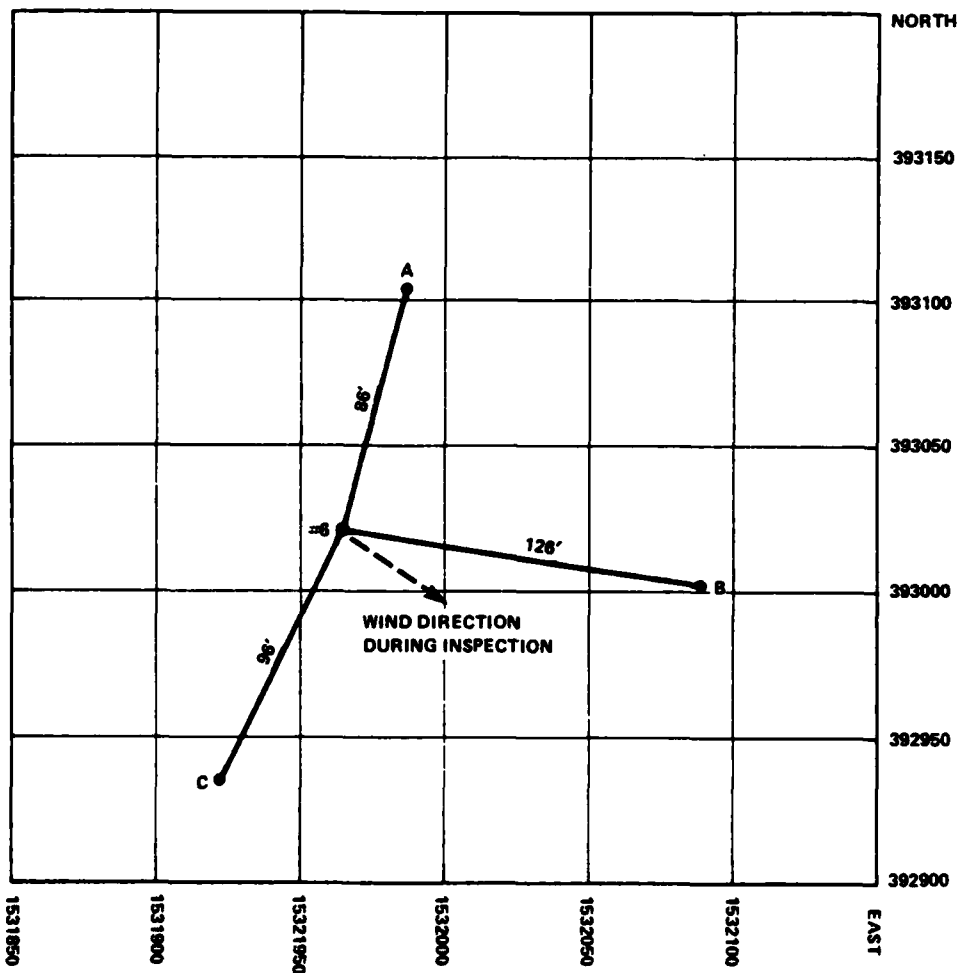


NOTE: COORDINATES IN WASHINGTON STATE LAMBERT NORTH SYSTEM

Table A-6. Pop Float to Buoy Distances as Sighted from Land  
(Indian Island)

Leg No.	Pop Float North Coord.	Pop Float East Coord.	Buoy North Coord.	Buoy East Coord.	Distance (ft)
A	393104.01	1531988.16	393021.37	1531965.15	86
B	393003.80	1532089.84			126
C	392935.66	1531921.64			96

MOORING =6  
CONFIGURATION



NOTE: (1) COORDINATES IN WASHINGTON STATE LAMBERT NORTH SYSTEM  
(2) A, B AND C ARE POSITIONS WHERE CHAIN LEGS ENTER THE BOTTOM

**ANNEX B**

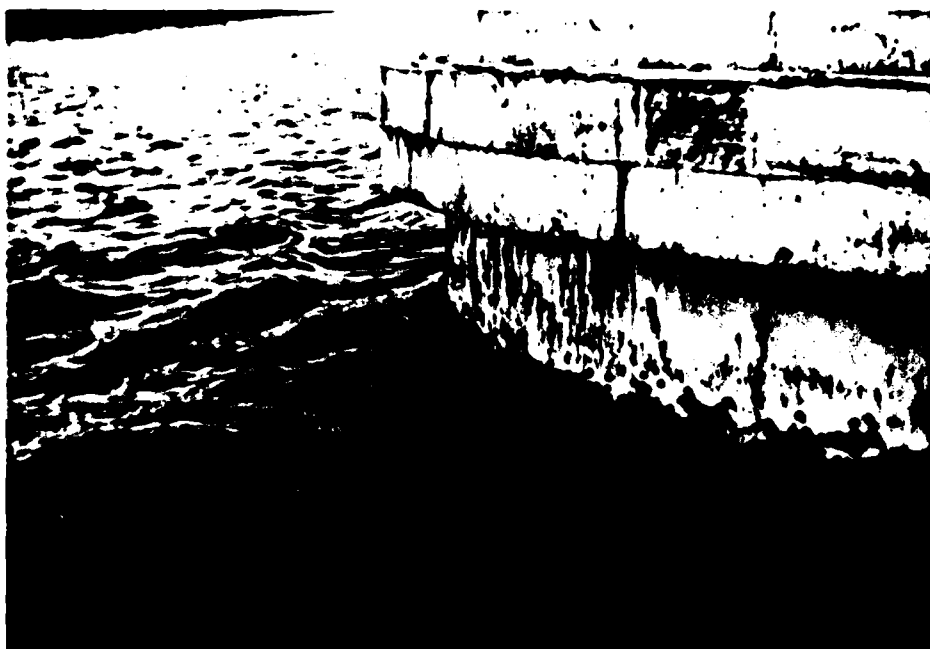
**PHOTOGRAPHS**



**Buoy #2; from diveboat**



**Buoy #2; showing typical condition of rubbing railings and top jewelry**



**Buoy #2; showing typical growth at waterline and top fender condition**



**Buoy #6; from diveboat**

**ANNEX C**

**POST-INSPECTION MESSAGE**





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